

In1226WOA05.doc  
24.03.04  
PCT/DE03/00861

- 1 -

Patent claims

1. Method for filling a contact hole (20),  
in which a base layer (50) is deposited in at  
least one contact hole (20) under a protective  
gas, which base layer comprises titanium nitride,  
and in which a covering layer (54) is deposited in  
the contact hole (20) after the deposition of the  
base layer (50) under gaseous nitrogen, which  
covering layer comprises titanium nitride,  
in which case, by virtue of the fact that firstly  
the base layer is deposited under a protective  
gas, on the metal at the bottom of the contact  
hole no nitride compounds form between the metal  
at the bottom of the contact hole and nitrogen  
contained in a reactive gas,  
and a contact hole filling made of tungsten being  
deposited in the contact hole (20) after the  
deposition of the covering layer (54),  
characterized in that the covering layer (54), at  
the bottom (24) of the contact hole, has a  
thickness (D4) of less than 10 nm.
2. Method according to Claim 1, characterized in that  
the base layer (50) and/or the covering layer (54)  
is deposited by directional sputtering.
3. Method according to Claim 1 or 2, characterized in  
that an intermediate layer (B3, B4) is deposited  
in the contact hole (20) after the deposition of  
the base layer (50) and before the deposition of  
the covering layer (54) preferably by directional  
sputtering, at least eighty per cent of the atoms  
of the intermediate layer being titanium atoms.

4. Method according to one of the preceding claims,  
characterized in that at least one region (B3, B4)  
of the intermediate layer (52) is deposited from a  
nitride-free surface of a sputtering target (108)  
5 under a protective gas.
5. Method according to one of Claims 2 to 4,  
characterized in that the surface (157) of the  
sputtering target, for the sputtering of the base  
10 layer (50), is nitrided before the deposition of  
the base layer (50) under nitrogen.
6. Method according to one of Claims 2 to 5,  
characterized in that the base layer (50) and the  
15 covering layer (54) and preferably also the  
intermediate layer (52) are produced using the  
same sputtering target (108).
7. Method according to one of the preceding claims,  
20 characterized in that the contact hole (20) is  
introduced into a dielectric layer (18) as far as  
an electrically conductive connecting section  
(14),  
and in that the connecting section (14) preferably  
25 contains aluminium or an aluminium alloy as main  
constituent.
8. Method according to Claim 7, characterized in that  
a multiplicity of contact holes (20) are etched  
30 simultaneously into the dielectric layer (18),  
in that an electrically conductive auxiliary layer  
(16), preferably an antireflection layer, is  
arranged between the dielectric carrier material  
(18) and the connecting section (14),

5 and in that the auxiliary layer (16) is used as a stop layer during the etching, a penetration of the auxiliary layer (16) occurring at thin locations of the dielectric layer and/or at locations with a higher etching rate, however.

9. Method according to one of the preceding claims, characterized in that the contact hole filling is deposited using tungsten hexafluoride.

10

10. Method according to Claim 3, characterized in that the base layer (50) together with the intermediate layer (52), at the bottom (24) of the contact hole, has a thickness (D2, D3) of less than 5 nm, in particular less than 3 nm.

15

11. Method according to one of the preceding claims, characterized in that the contact hole (20) has a diameter of less than 1  $\mu\text{m}$ , preferably of about 0.5  $\mu\text{m}$ , and/or in that the contact hole (20) has a depth of greater than 500 nm, preferably greater than 1  $\mu\text{m}$ .

20

25 12. Integrated circuit arrangement (10), having at least one contact hole (20), in which a base layer (50) and a covering layer (54) made of titanium nitride are arranged, the base layer (50) adjoining a connecting section (14) made of aluminium or an aluminium alloy and no aluminium nitride being arranged between the connecting section (14) and the base layer (50), and the contact hole (20) containing a filling made of tungsten,

30

characterized in that the covering layer (54) has, at the bottom (24) of the contact hole, a thickness (D4) of less than 10 nm.

- 5 13. Circuit arrangement according to Claim 12,  
characterized in that, in an intermediate layer  
(52) arranged between the base layer (50) and the  
covering layer (54), at least eighty per cent of  
the atoms of the intermediate layer are titanium  
10 atoms.
14. Circuit arrangement according to Claim 13,  
characterized in that the base layer (50) together  
with the intermediate layer (52), at the bottom  
15 (24) of the contact hole, has a thickness (D2, D3)  
of less than 5 nm, in particular less than 3 nm.